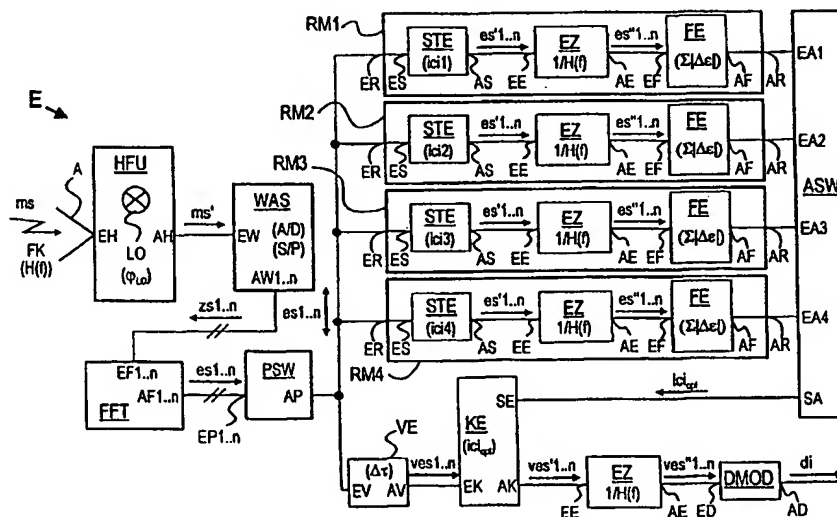


(54) Title:	METHOD, USE OF SAID METHOD AND RECEIVER SYSTEM FOR RECEIVING MULTI-CARRIER SIGNALS PRESENTING SEVERAL FREQUENCY-DISCRETE SUBCARRIERS
(54) Bezeichnung:	VERFAHREN, VERWENDUNG DES VERFAHRENS UND EMPFANGSANORDNUNG ZUM EMPFANG VON MEHRERE FREQUENZDISKRETE SUBTRÄGER AUFWEISENDEN MULTITRÄGERSIGNALEN

In a received multi-carrier signal (ms) which presents subcarrier-specific interference (ici0) caused by adjacent subcarriers (st1...n) said subcarriers (st1...n) are additionally subjected to interference in a targeted manner and a correction information (iciopt) which represents the subcarrier-specific interference (ici0) is derived from the subcarriers (st1...n). The received subcarriers (st1...n) are then corrected by means of the correction information. Low-cost oscillators can advantageously be used to produce economical transmitter and receiver units.



## Patent Claims

1. A method for receiving a multicarrier signal (ms) having a number of frequency-discrete subcarriers (st1...n) and into which information is inserted which is converted by means of a multicarrier method to frequency-discrete modulation-specific modulation symbols with the individual frequency-discrete subcarriers (st1...n) of the multicarrier signal (ms) transmitted via a transmission medium (FK) each being subject to subcarrier-specific disturbances (ici0) caused by subcarriers (st1...n) arranged adjacent in the frequency domain,
- characterized
- in that the subcarriers (st1...n) of the received multicarrier signal (ms) are additionally deliberately subjected to disturbances,
  - in that correction information (ici<sub>opt</sub>) which represents the subcarrier-specific disturbances (ici0) is derived from the subcarriers (st1...n) which have been additionally deliberately subjected to disturbances, and
  - in that the subcarriers (st1...n) of the received multicarrier signal (ms) are corrected in accordance with the determined correction information (ici<sub>opt</sub>).
2. The method as claimed in claim 1, characterized in that a number of different test disturbances (icix) are provided, with the subcarriers (st1...n) being deliberately subjected to disturbances, in the event of a test disturbance

(icix), by means of constant or frequency-dependent disturbance information (icil...4).

3. The method as claimed in claim 2,  
5 characterized
- in that the received symbols (es1...n) which represent frequency-discrete subcarriers (st1...n) are derived from the received multicarrier signal (ms),
  - 10 - in that k differently defined reference disturbance information items (icil...4) are provided, in which case, for each reference disturbance information item (icil...4),

- 5                   -- (a)   the received symbols ( $es1...n$ ) in the  
                      subcarriers ( $st_{i,1}$ ,  $st_{i,1}$ ) which are in  
                      each case arranged adjacent around at  
                      least some of the subcarriers ( $st_i$ ) in  
                      the frequency domain are each subjected  
                      to disturbances from the reference  
                      disturbance information ( $icil...4$ ), and  
                      the disturbed received symbols in the  
                      adjacent subcarriers ( $st_{i,1}$ ,  $st_{i,1}$ ) are  
10                   then additively superimposed as  
                      deliberate test disturbances ( $icix_1$ ,  
                       $icix_1$ ) on the received symbol ( $es1...n$ )  
                      in the additionally disturbed subcarrier  
                      ( $st_i$ ),
- 15                   - (b)   in that the additionally deliberately  
                      disturbed received symbols ( $es'1...n$ )  
                      are each compared with the closest  
                      modulation-specific modulation symbol,  
                      and subcarrier-specific error  
20                   information ( $\Delta s1...n$ ) is formed as a  
                      function of the comparison results, and
- (c)   disturbance-information-specific sum  
                      error information ( $se1...k$ ) is formed  
                      from the subcarrier-specific error  
25                   information ( $\Delta s1...n$ ), and
- (d)   in that the correction information  
                      ( $ici_{opt}$ ) is derived from the  $k$  reference  
                      disturbance information items ( $icil...k$ )  
                      and the  $k$  sum error information items  
30                   ( $se1...k$ ).

4.   The method as claimed in claim 3,  
      characterized

- 35       - in that the frequency-discrete received symbols  
          ( $es1...n$ ) derived from the received  
          multicarrier signal ( $ms$ ) are delayed or are

temporarily stored until the correction information ( $ici_{opt}$ ) has been established,

- 5           - (e)   in that the delayed received symbols ( $ves1...n$ ) in the subcarriers ( $st_{1,1}, st_{1,2}$ ) which are in each case arranged adjacent around a subcarrier ( $st_i$ ) in the frequency domain are each corrected by the determined correction information ( $ici_{opt}$ ), and are then additively
- 10           superimposed on the delayed received symbol ( $ves1...n$ ) in the subcarrier ( $st_i$ ).

5. The method as claimed in claim 3 or 4,  
characterized

in that the k reference disturbance information items (ici1...k) and the k disturbance-information-specific sum error information items (se1...k) derived from them are used to establish a correction function (KF) which is used to calculate the correction information (ici<sub>opt</sub>).

6. The method as claimed in claim 5,  
characterized

- in that four defined reference disturbance information items (ici1...4) are provided, and are used to derive the four disturbance-information-specific sum error information items (se1...4) and  
- in that the correction information (ici<sub>opt</sub>) is calculated by

$$ici_{opt} = \left( \frac{se4 - \frac{(se1 + se3)}{2}}{2(se1 - se3)} \right) \cdot (ici1 - ici3) + \frac{ici4}{2}$$

where

se1...4 represents the four sum error information items (se1...4), and

ici1...4 represents the four reference disturbance information items (ici1...4).

7. The method as claimed in claim 3 or 4,  
characterized

in that the correction information (ici<sub>opt</sub>) is determined in the course of an iterative search, with the k reference disturbance information items (ici1...4) being established in the course of the iterative search, and the steps (a) to (c) being

repeated until a minimum value of the disturbance-information-specific sum error information ( $e_{min}$ ) is determined, and the correction information ( $ici_{opt}$ ) has been derived from this.

8. The method as claimed in one of claims 3 to 7,  
characterized  
in that the additionally deliberately disturbed  
received symbols ( $es'1...n$ ) are in each case  
corrected by equalization as a function of  
frequency-selective transmission characteristics  
( $H(f)$ ) of the transmission medium (FK) before the  
comparison with the respective closest modulation-  
specific modulation symbol.
9. The method as claimed in one of claims 3 to 8,  
characterized  
- in that, once steps (a) to (d) have each been  
carried out for each reference disturbance  
information item ( $icil...4$ )  
-- (a') the received symbols ( $es1...n$ ) of the  
subcarriers ( $st_{1,b}$ ,  $st_{1,b}$ , where  $b > 1$ )  
which are each arranged further away  
from at least some of the subcarriers  
( $st_1$ ) in the frequency domain are each  
subjected to disturbances from the  
reference disturbance information  
( $icil...4$ ), and the disturbed received  
symbols are then additively superimposed  
as deliberate test disturbances ( $icix_1$ ,  
 $icix_1$ ) on the received symbol ( $es1...n$ )  
of the additionally disturbed subcarrier  
( $st_1$ ), and  
-- steps (b) to (d) are then carried out.
10. The method as claimed in one of claims 2 to 9,  
characterized  
- in that the received symbols ( $ves'1...n$ ) which  
have been corrected using the correction  
information ( $ici_{opt}$ ) are demodulated,,

- in that errors are identified in the demodulated received symbols ( $d_i$ ) using error identification information inserted into the transmitted information, and identified, erroneous received symbols ( $es'1...n$ ,  $es''1...n$ ) are corrected,
- in that, when errors are identified, steps (b) to (d) are carried out once again, with the corrected received symbols ( $es'1...n$ ,  $es''1...n$ ) being used for determining the correction information ( $ici_{opt}$ ).

11. The method as claimed in one of the preceding claims,  
characterized  
in that the multicarrier method is provided by  
means of an OFDM transmission method - Orthogonal  
Frequency Division Multiplexing - or by means of a  
transmission method based on discrete multiple  
tones - DMT.
12. The method as claimed in one of the preceding claims,  
characterized  
in that the transmission medium is in the form of  
a wireless radio channel or a cable-based or wire-  
based transmission channel.
13. The method as claimed in claim 12,  
characterized  
in that the information is transmitted via power  
supply lines.
14. Use of the method according to the invention as  
claimed in one of the preceding claims,  
characterized
- in that the received multicarrier signal (ms)  
is demodulated,
  - in that errors contained in the demodulated  
multicarrier signal (di) are identified using  
an error handling routine and are corrected,
  - in that the method is carried out in order to  
deliberately disturb the received multicarrier  
signal (ms) as a function of the number and  
correctability of the errors.
15. A receiving arrangement for receiving a  
multicarrier signal (ms) having a number of

frequency-discrete subcarriers (st1...n) and into  
which information is inserted which is converted  
into frequency-discrete modulation symbols by  
means of a multicarrier method,  
5 with the individual frequency-discrete subcarriers  
(st1...n) of the multicarrier signal (ms)  
transmitted via a transmission medium (FK) each  
being subject to subcarrier-specific disturbances  
(ici0)

10

caused by subcarriers (st1...n) arranged adjacent in the frequency domain, characterized

- 5       - in that disturbance means (RM1..4) are provided for additional, deliberate disturbance of the received multicarrier signal (ms),
- 10       - in that means (ASW) are arranged for deriving correction information ( $ici_{opt}$ ), which represents the subcarrier-specific disturbances ( $ici0$ ), from the additionally deliberately disturbed subcarriers (st1...n, es'1...n, es''1...n), and
- 15       - in that means (KE) are provided for correction of the frequency-discrete subcarriers (st1...n, ves1...n) as a function of the determined correction information ( $ici_{opt}$ ).

**Abstract**

Method, use of the method and a receiving arrangement for receiving multicarrier signals having a number of frequency-discrete subcarriers

In a received multicarrier signal (ms) which is subject to subcarrier-specific disturbances ( $ici_0$ ) caused by adjacent subcarriers ( $st1...n$ ), the subcarriers ( $st1...n$ ) are additionally deliberately subjected to disturbances, and correction information ( $ici_{opt}$ ) which represents the carrier-specific disturbances ( $ici_0$ ) is derived from the subcarriers ( $st1...n$ ) which have been additionally deliberately subjected to disturbances and is then used to correct the received subcarriers ( $st1...n$ ). Low-cost oscillators can advantageously be used to provide cheap transmitting and receiving units.

FIG 2